# A systematic review of the methods and drugs used for performing suprascapular nerve block injections for the non-surgical management of chronic shoulder pain.

**Abstract**

Suprascapular nerve block injections are growing in popularity as a treatment option for people with chronic shoulder pain. The optimal method of injection and aftercare is unknown. This review describes the current methods and drugs used for performing suprascapular nerve block injections in the non-surgical management of adults with chronic shoulder pain in order to inform future research in this area.

Systematic searches of CINAHL, Medline (OVID), AMED, EMBASE databases and The Cochrane Library were undertaken from inception to June 2020. Data on the method and drugs used for injection and aftercare was extracted and summarised for areas of commonality and discrepancy.

We included 53 studies in this review. In total 8 different injection methods were reported within the included studies. Indirect surface land-marked methods were the most common method reported in 21 studies. Direct surface land-marked methods were reported in 12 studies. Ultrasound guided methods used alone, were reported in 16 studies. Both fluoroscopy and computer tomography methods used alone, were reported in 1 study each. Electromyography was used in combination with other injection methods in 9 studies. Wide variation in the composition of the injectate was observed between studies. Local anaesthetic was used within injectate preparations in all studies. Local anaesthetic used alone was reported in 20 studies, combined with steroid in 29 studies and combined with various other components in 5 studies. Physiotherapy following injection was reported in 26 studies. Reported details of physiotherapy varied considerably.

This review identified substantial variation in the methods and drugs used to perform suprascapular nerve block injection in clinical trials. **Current literature is inadequate to define best practice in suprascapular nerve block injection.** Consensus research defining best practice suprascapular nerve block injection is now needed in order to standardise the approach for a future multi-centre clinical trial to evaluate its effectiveness.

Key words: Suprascapular nerve block, Shoulder pain.

## 1. Introduction

Chronic shoulder pain is a major cause of disability.[1] Its prevalence is between 2.4 -14%. Around 20% of those affected report shoulder pain at one year and 14% of people report shoulder pain at three years.[2,3] Annually approximately 1.5 million GP consultations are related to shoulder pain in England alone with the total annual societal costs of shoulder pain in the United Kingdom (UK) estimated to be £100 million.[4]

Shoulder pain can arise from multiple structures, making a clinical diagnosis challenging.[5] The best treatment for people with persistent shoulder pain is uncertain. Physiotherapy is often the first line treatment for shoulder pain. Local steroid injections can provide short term benefit for up to three months[6] and are used for the management of shoulder pain within physiotherapy practice.[7–10] At best local steroid injections have short term benefits.[6] Repeat local steroid injections may have negative effects on tendon homeostasis, healing, and future treatment outcomes for some patients.[11–14] Suprascapular nerve block injections may offer an effective alternative to local steroid injections for some patients and there is growing interest in their use including within physiotherapy practice.[15,16]

The suprascapular nerve is a mixed motor and sensory nerve that supplies approximately 70% of the sensory innervation to the shoulder complex.[17,18] Injections aiming to block the suprascapular nerve are used in the management of a range of chronic shoulder conditions.[15,19] The mechanisms contributing to the clinical effectiveness of SSNB injections are unclear.[20] SSNB injections are recommended in the British Elbow and Shoulder Society (BESS) guidelines for the management of chronic subacromial shoulder pain[21] and glenohumeral osteoarthritis.[22]

A 2018 survey of BESS medical consultant and registrar members found that around 40% of respondents would use SSNB injection in the management of patients with large and massive rotator cuff tears.[16] A 2019 survey of UK physiotherapists who regularly treat patients with shoulder pain found that the most common shoulder condition that they would consider using SSNB injections for was rotator cuff tear arthropathy (glenohumeral joint osteoarthritis associated with cuff tears).[15] Some authors suggest that people with large to massive rotator cuff tears may also have an element of suprascapular neuropathy that may be more responsive to a SSNB injection.[23]

There is limited research surrounding the effectiveness of SSNB injections in these patient groups and compared to local steroid injections.[19,24] Multiple methods and drugs are used for SSNB injections.[25] The optimum method and aftercare has not been defined. Defining best practice in SSNB injections, and the adjunct physiotherapy interventions used are first steps towards designing robust randomised controlled trials. The aim of this review was to identify the methods and drugs used for performing SSNB injections for people with chronic shoulder pain and whether physiotherapy interventions were used as an adjunct treatment following the injection.

## 2. Methods

### 2.1 Search methods and strategy

Electronic searches of CINAHL, Medline (OVID), AMED, EMBASE, and The Cochrane Library were conducted from inception to June 2020. The electronic search was supplemented by hand searching of reference lists of retrieved full text articles and citation searching. The search strategy and search terms were developed with the support of a medical librarian (SJ). Search strategies for all databases are available in appendix one.

### 2.2 Study Selection

Screening for relevant articles by title and abstract was undertaken independently by the lead author (NS). Full text articles were then assessed for eligibility using the predefined inclusion and exclusion criteria **(Box 1)** by two researchers independently (NS, ZL). Where there were discrepancies in decisions made between the two reviewers, these articles were forwarded to a third reviewer (RK) who made a final decision. Full text articles that met the inclusion criteria were included in this review.

### 2.3 Data extraction and synthesis

Data on the SSNB injection method used, the components making up the injectate and whether physiotherapy was delivered following the injection was extracted into predefined data extraction tables. A narrative synthesis of the findings is presented.

## Results

### 3.1 Study selection

Our search returned 3552 results from which we removed 980 duplicates. We screened a total of 2572 records by title and abstract. We retrieved and assessed 89 full text articles for eligibility of which 53 were included. Articles excluded were recorded at the different stages of the eligibility screening process and reported in a PRISMA (preferred reporting items for systemic reviews and meta-analysis) flow diagram **(Fig. 1)**.

### 3.2 Study characteristics

We included 53 studies from 14 different countries in this review **(Table 1)**. Of which 13 studies came from Turkey,[26–38] 7 each from Australia[20,23,39–43] and India,[44–50] 6 from the UK,[51–56] 4 each from the USA[57–60] and South Korea,[61–64] 2 each from Brazil,[65,66] Canada,[67,68] Egypt[69,70] and Italy[71,72] and 1 each from Columbia,[73] Austria,[74] Nepal[75] and Thailand.[76]

We included 28 randomised controlled trials (RCTs),[23,26,27,29–31,33,35,36,38,41–44,46,48–52,55,57,61,67,68,70,72,76] 21 observational studies,[20,28,32,34,37,39,45,53,54,57,58,62–66,69,71,73–75] 3 audits[40,59,60] and 1 service evaluation.[56] Participant numbers were generally small within the included RCTs ranging from 10 participants[76] to 100 participants.[47,49] Of the included observational studies again participant numbers were generally small ranging from 9 participants[58] to 102 participants.[64] The largest number of SSNB injections reported within a single study was from

a retrospective audit of patient records that included 1005 SSNB injections undertaken within a Community Rheumatology service in Australia.[40]

### 3.3 Population and shoulder conditions

A wide range of shoulder disorders were included in this review. Of the 53 studies included, 15 were undertaken with participants with a diagnosis of frozen shoulder,[28,30,46–49,55,57,58,64,65,68–70,75] 10 with participants with post stroke shoulder pain,[26,27,29,32,33,35,43,63,71,76] and 10 with participants with a range of different musculoskeletal shoulder disorders.[37,41,42,44,56,60,62,66,67,74] 6 studies were undertaken with participants with rotator cuff related shoulder pain, of which 2 were with participants with a diagnosis of impingement syndrome,[31,36] and 1 each with participants with rotator cuff tears,[23] rotator cuff disease,[20] rotator cuff tendinitis and / or tears[51] and rotator cuff tendinitis.[72] 4 studies were undertaken with participants who had either a musculoskeletal shoulder disorder or a neurological condition causing their shoulder pain.[40,50,53,73] 3 studies were undertaken with participants with non-specific shoulder pain, where no diagnosis was provided.[38,45,61] 1 study was undertaken in participants with rheumatoid arthritis,[52] either rheumatoid arthritis and /or osteoarthritis,[54] myofascial trigger point shoulder pain,[59] motor neurone disease,[39] and with participants who developed shoulder pain following mastectomy for breast cancer.[34]

### 3.4 Injection methods

A variety of different surface land-marked and guided SSNB injection methods were reported within the included studies **(Fig. 2)**.

Surface land-marked methods without any use of guidance were used in 32 studies. Of these the indirect surface land-marked approach was reported in 20 studies[20,36,39–44,50,53–55,57,65,68,69,72,74–76] and the direct suprascapular notch surface land-marked approach was reported in 10 studies.[27,29,30,35,38,51,56,59–61] In 1 study the direct spinoglenoid notch method was used[45] and in 1 study a combination of both the direct suprascapular notch and indirect method was used.[52] Ultrasound guidance used alone was reported in 16 studies.[23,26,27,32,34,46,47,49,50,56,61,63,64,66,70,71] Fluoroscopy used alone and Computer topography (CT) used alone was each reported in 1 study.[62] [41] The additional use of Electromyography (EMG) was reported in 9 studies, of which 4 combined EMG with a surface-landmarked method,[30,35,48,58] 3 combined EMG with fluoroscopy[28,33,67] and 2 combined EMG with ultrasound.[37,73] From the studies included in our review the earliest injection method reported was the land-marked direct suprascapular notch method in 1986.[60] The land-marked indirect method was first reported in 1994.[53] The earliest guided SSNB injection methods reported were EMG guided in 1992,[58] CT guided in 2004,[41] ultrasound guided in 2010[61] and fluoroscopy guided in 2012.[62] The most commonly reported injection method within the last decade was ultrasound guided SSNB injections in 16 studies **(Fig. 3)**.

Of the 53 studies included in this review 6 studies compared different injection methods. 1 study compared ultrasound guided injection with the land-marked indirect method. [50] 2 studies compared ultrasound guided injection with the land-marked direct method. [56,61] 2 studies compared EMG land-marked with the land-marked direct method [30,35] and 1 study compared CT guided injection to the land-marked indirect method. [41]

### 3.5 Medication used

In total 21 different combinations of medication were used within the injectates for SSNB injection for the studies included in this review with Bupivacaine combined with Methylprednisolone being the most common in 12 studies **(Fig. 4)**.

Local anaesthetic was used in all 53 studies. Local anaesthetics were used alone in 20 studies,[27,29,58–60,62,63,67,68,70,74,76,30,33,37,38,46,49,54,57] used with steroid in 29 studies[20,23,26,28,32,34–36,39–45,47,48,50–53,55,56,64,66,69,71,73,75] and used with a combination of steroid and other injectate components such has saline,[27,72] serum,[32] adrenaline[65] and dextrose[61] in a further 5 studies. No study used steroid alone **(Fig. 5)**.

Bupivacaine was the most common local anaesthetic used at various concentrations and volumes in **30** studies.[20,31,46,47,49–53,55,58,59,33,60,64–66,68–71,73,75,34,39–44] Of which 24 studies reported using 0.5% Bupivacaine[20,31,46,49,51–53,55,64,65,68,69,33,70,71,73,75,34,39–44] and 6 studies reported using 0.25% Bupivacaine.[47,50,58–60,66] Bupivacaine was used at different volumes ranging from 10ml of 0.5% Bupivacaine,[20,39–44,55,64,68,70,71] 3ml of 0.25% Bupivacaine [66] to 1ml of 0.5% Bupivacaine.[51]
Lidocaine was the choice of local anaesthetic used in 16 studies.[26,27,61,63,67,72,75,76,28,30,32,38,45,48,56,57] Of which 10 studies reported using 1% Lidocaine,[28,30,38,45,56,57,63,67,75,76] 4 studies used 2% Lidocaine,[26,27,61,72] and 2 studies used 10% Lidocaine.[32,48] Lidocaine was used at various volumes ranging from 2ml of 10%,[32] 2ml of 2%[61] and 2ml of 1%[67] Lidocaine to 10ml of 1% Lidocaine.[30,38,45,56,76] A combination of Lidocaine [5ml,1%] mixed with Bupivacaine [4ml,0.5%] was used in 1 study.[75]
Prilocaine was used in 5 studies.[29,35–37,54] Of which, Prilocaine 2% was used in 3 studies[29,36,37] and Prilocaine 1% used in 2 studies.[35,54] The volume of Prilocaine ranged from 10ml of 2% Prilocaine[29] to 4ml of 1% Prilocaine. [54]
Ropivacaine was used in 2 studies.[23,74] Of which, 1 study used 1ml of 1% Ropivacaine[23] and 1 study used 5ml of 0.5% Ropivacaine.[74]
Mepivacaine [2ml,1%] was used in 1 study.[62]

The lowest volume of local anaesthetic used was 1ml of 1% Ropivacaine combined with 1ml of Betamethasone delivered by ultrasound.[23] The largest volume of local anaesthetic used was 10ml of 0.5% Bupivacaine,[20,39–44,55,64,68,70,71] 10ml of 1% Lidocaine,[30,38,45,56,76] 10ml of 2% Lidocaine[72] and 10ml of 2% Prilocaine[29] by both land-marked and ultrasound guided techniques. The largest dosage of local anaesthetics reported was 400mg of Lidocaine [4ml/10%] injected using EMG guidance,[48] 200mg of Lidocaine [2ml/10%] injected using ultrasound guidance[32] and 200mg of Lidocaine [10ml/2%] delivered land-marked.[72] Conversely the smallest dosage of local anaesthetic used was 5mg of Bupivacaine [1ml/ 0.5%] injected using

the surface land-marked direct suprascapular notch method.[51] The mean dosage of Bupivacaine used was 36.25mg for land-marked and 28.18mg for guided methods. The mean dosage of Lidocaine used was 107mg for land-marked and 130mg for guided methods **(Fig. 6)**.

Methylprednisolone was the most common steroid used in combination with local anaesthetic in 16 studies.[20,28,39–45,47,50,51,53,56,71,75] Of which, 40mg was used in 15 studies[20,28,39–45,47,50,51,56,71,75] and 80mg was used in 1 study.[53] Triamcinolone was used in 7 studies.[26,34,36,48,55,64,66] Of which, 40mg was used in 4 studies[26,36,48,66] and 20mg in 3 studies.[34,55,64] Betamethasone at a volume of 1ml was used in 4 studies.[23,27,32,35] Dexamethasone was used in 2 studies.[69,73] Of which 1 study reported using 1ml of Dexamethasone[69] and the other study reported using 4mg of Dexamethasone.[73] Prednisolone 40mg was used in 1 study.[52] Only 1 study compared the effectiveness of SSNB injections given with or without steroid.[66]

### 3.6 Additional treatment following SSNB injections

The use of physiotherapy as an adjunct intervention following SSNB injection was reported in 26 studies **(Table 2)**.[23,26–28,31–34,36,43,44,46,48,49,55–58,63,64,68–70,72,75,76] Most physiotherapy interventions included some aspect of shoulder exercises, either physiotherapy led or in the form of home exercises with written and verbal advice after SSNB injection. The specific details of the reported physiotherapy intervention and exercises varied considerably between studies. No study evaluated if physiotherapy maximised any potential benefit or improved long term outcomes in participants after SSNB injection.

## 4.0 Discussion

The aim of this systematic review was to identify the methods and drugs used for performing SSNB injections in the management of chronic shoulder pain and what adjunct physiotherapy interventions are used following injection. We have not included studies of modulation techniques targeting the suprascapular nerve. This is an important piece of work but is beyond the scope of this review which we have done to inform future research on injections used for SSNBs. Similarly, we are not seeking to draw any conclusions here on the clinical effectiveness of SSNBs. **A systematic review is needed but is, again, a separate piece of work.**

In our systematic review we found that a variety of injection methods and medications can be used for SSNB injections. The direct surface land-marked method first described by Wertheim and Rovenstine (1941)[77] was reported in 12 studies in our review. This direct approach aims to deliver the injectate directly into the suprascapular notch where the suprascapular nerve enters the scapular. The direct approach is reported to pose a greater risk of pneumothorax, nerve damage and veno-puncture, due to potential needle tip injury to the suprascapular nerve, suprascapular blood vessels and the apex of the lung if the needle tip penetrates too deeply through the suprascapular notch, compared to the indirect approach.[40]

Dangoisse et al (1994)[53] demonstrated that it was not essential to use the direct suprascapular notch approach for SSNB injection. An indirect approach where a deposit of 5-10 ml of injectate delivered deep into the supraspinatus fossa, away from the suprascapular notch, was sufficient to fill the supraspinatus fossa and bathe the suprascapular nerve, thereby reducing the risks associated with the direct approach.[53] The indirect approach was a common method,

reported in 20 studies in our review. The indirect approach appears to be a safe and well tolerated method of SSNB injection. A retrospective case audit of over 1005 SSNB injections, administered utilising the indirect approach, revealed no serious complications with this method.[40]

In total 16 studies utilised ultrasound guidance for SSNB injections in our review. Ultrasound guided approaches were the most common method for SSNB injection within our review for studies published within the last decade, presumably due to technological advances, training opportunities and equipment availability. The earliest study in our review using ultrasound guidance for SSNB injection was in 2010.[61] Ultrasound guidance removes the radiation risks associated with other guided approaches such has fluoroscopy and CT guided injections which appear to have become less common over time. Although the use of ultrasound guidance may be needed for accurate needle placement for denervation procedures at the suprascapular nerve at present there is insufficient evidence regarding the efficacy of ultrasound guided SSNB injections compared to surface land-marked SSNB injection approaches.[24]

Some authors suggest that using guided nerve block methods facilitates the use of lower drug dosages to achieve effective blockade, however this was not always consistent with the trends and patterns of practice reported within studies in our review. In fact, the largest dosage of local anaesthetic used was 400mg of Lidocaine [4ml/10%] delivered utilising EMG[48] and the smallest dosage of local anaesthetic used was 5mg of Bupivacaine [1ml/ 0.5%] injected using the surface land-marked direct suprascapular notch method.[51]

Within the 53 studies in this review 21 different variations of drugs were used for SSNB injections, with further variation in the volumes and concentrations of drugs. Local anaesthetic was used alone in 20 studies, combined with steroid in 29 studies and combined with various other components in 5 studies. Robust evidence supporting the addition of corticosteroid to local anaesthetic in the hope it prolongs the duration of nerve blockade or the effectiveness of nerve block injection is lacking.[78] Only 1 small study undertaken with 34 stroke patients compared the effectiveness of SSNB injection with and without the addition of steroid.[66] Although a trend in favour of the addition of steroid was seen no statistical differences were observed in pain scores post injection compared to placebo injection and SSNB given with local anaesthetic alone. At present it remains unclear if the addition of corticosteroid to local anaesthetic for SSNB injection improves outcomes.

This review indicates that injection method, choice of drug, drug dosage, volume and concentration, used for SSNB injection may be based upon clinician preference rather than evidence based. Although physiotherapy interventions were commonly employed following SSNB injection, in 26 of the studies included in this review, there was wide variation in the interventions and methods of delivery. Many of the studies included in our review had heterogenous cohorts of patients with mixed shoulder conditions. Although patients with large to massive rotator cuff tears and patients with rotator cuff arthropathy appear to be common patients groups selected to receive SSNB injection in clinical practice in the UK[15,16] interestingly our review found no clinical trials specifically focusing on these patient groups to support this trend.

## 5.0 Conclusion

This review identified substantial variation in the methods and drugs used to perform SSNB injection in clinical trials. Standardisation of the delivery method and drug used for SSNB injection is required in order to evaluate its effectiveness in a multi-centre clinical trial. **The current literature is inadequate to define best practice in SSNB injection for standardisation in a future clinical trial.** Consensus research on defining best practice in SSNB injection is therefore now needed. This will ensure delivery of the intervention is standardised, can be delivered consistently across different trial sites, and is reproducible in clinical practice.

## Conflict of interest statement

The authors have no conflicts of interest to declare.


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Author contributions: NS developed the search strategy along with SJ
NS performed the searches, data collection and data analysis and eligibility of studies. ZL performed secondary data analysis and assessment of eligibility of studies. RK performed data analysis and eligibility of studies in cases of discrepancies. NS, RK, DE and MU all contributed to data analysis, data synthesis, writing and editing of the article. All authors were responsible for approval of the final draft.

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